Tracing the evolution of critical evaluation skills in students' use of the Internet

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This paper documents the evolving uses of the Internet made by public health graduate students and traces the development of their search methods and critical evaluative criteria. Early in the first semester and again six months later, twenty-four graduate students in a problem-based learning curriculum, which emphasizes evidence-based critical thinking skills, were required to describe their most helpful resources and to evaluate these resources critically. The answers were coded for the types of resources the students used, how frequently they were used, and why they were used. Student perception of the usefulness of resources, especially the Internet, and ability to evaluate these resources critically changed greatly. Initially, 96% of the students stated that the Internet was their most helpful resource. Six months later, these students continued to use the Internet; however, it was not their most useful source. At the later point, students had very specific uses for the Internet. Their most frequently used evaluation criterion was the reliability and objectivity of the source of the information. By the end of the first year of study, the majority of the students demonstrated an understanding of the principles of evidence-based practice and applied them to their research and analysis of information resources.

INTRODUCTION

Professionals need to make sound scientific decisions based upon accurate and current information coming from empirical research. Less acceptable methods for making decisions rely on anecdotes, rhetoric, or generalities [1]. The ability to evaluate information from all sources critically is the foundation for a new type of professional practice, which is called evidence-based practice [2]. The use of evidence-based practice implies that professionals assimilate current research findings into their knowledgebase and employ these findings to help in their decision making. The elements of evidence-based practice are embodied in the principles of lifelong learning. Necessary lifelong learning activities include conducting a thorough literature search and assessing the quality of the information gathered [3]. One of the basic tenets of evidence-based practice is that one must critically review the available data, by evaluating the accuracy and validity of the information gained. Evidence must come from reputable sources using valid and reliable methodology [4].

Among students in all fields, there appears to be almost blind trust that what is written is true. Roszak described this phenomenon with respect to electronic information as "technological idolatry" [5]. In the early 1980s in the context of end user database searching, Farber presciently noticed something he described as the "gee whiz" factor; the idea that "the computer will spew out the information or data, and students, believing that computers can do no wrong, will simply accept whatever comes out" [6]. This attitude seems to

apply in even greater degree to the Internet and the expanded kinds of electronic searching now available. Basically, when people find information in a computer via a database, an online catalog and especially the Web, they tend to trust that it is valid and true. This trust extends beyond the data to include faith that their results are correct and comprehensive. The results come from a computer, then "gee whiz," they must be true. In addition, Internet search results are often skewed toward accessing too many resources while in the earlier technologies a chief concern was that too few citations were retrieved. One result of too much material is that students fail to continue their investigation to a logical conclusion. They take the computer's results at face value, using whatever information comes out first, rather than critically evaluating it to determine what makes sense for their particular problem. Because the Internet provides so much information (some of which is unreliable) and makes it very accessible, students are producing superficial research papers [7].

With the growing use of the Web, articles are now appearing in many sources, from lay scientific journals [8] to professional publications [9] to *Consumer Reports* [10, 11] to local newspapers [12] on how to use it critically. Many of these articles describe how to find accurate, current, and reliable information and list useful search engines and Web sites. However, many students do not know how to evaluate the effectiveness of these electronic tools.

The purposes of this paper are to document the changing uses of the Internet in early graduate students in public health, and to chart the development of their searching methods and of their critical evaluative criteria.

METHOD

Description of the participants and their educational program

The twenty-five participants were first year students in a master's of public health program. One student dropped out of the program between the first and the second semester. This program uses problem-based learning (PBL) [13] as its major instructional method during the first year of the curriculum. Instead of teacher-directed lectures, students in a PBL curriculum meet in small groups to discuss professionally relevant problems or cases. As the students discuss a case, they describe what they currently know and develop questions that they cannot answer from their common knowledgebase. These questions form the basis for student-generated learning issues to be researched between class sessions. In this program, students are expected to identify and access resources on their own to address these knowledge gaps. After studying the information retrieved, students reassemble to discuss the case further and present their findings to their small group. During these discussions, the students share their new knowledge and insights, as well as the most useful resources they have identified. The content of the cases drives most of the student learning. This program emphasizes the development of critical thinking skills, including the critical evaluation of information from all sources. For example, the faculty facilitators in these small groups constantly question students about their results, the sources they consulted, and the reliability and validity of both the data and their source. Student discussions soon model these skills as students question each other and expect their peers' insights to be backed up with evidence from reliable sources. They are also evaluated on their critical thinking skills through written assignments and tests. Students in this study were not given any formal instruction on the use of the Internet and only a basic orientation to the library.

The first semester of the two-year, full-time program emphasizes epidemiology and biostatistics, while the second semester emphasizes behavioral sciences such as health behaviors, developmental psychology, and health promotion. The second year curriculum emphasizes health management, leadership, and policy. Cases are organized in multiple-week periods called blocks that highlight central themes or topics. Throughout the curriculum, these core public health disciplines are emphasized using cases in which the contexts are common, public health problems facing our current society.

Procedure

In the fall of 1996, eight weeks into the first semester students were given a take-home examination. The students had completed eight cases prior to this examination. One of the questions on this examination asked students to list their most helpful resources, justify why they were most useful, and to evaluate these resources critically. The answers were graded excellent, pass, marginal pass, or unsatisfactory. The students received their grade on the questions, along with limited feedback about shortcomings in their answers. Model answers were not distributed, nor did the students receive any specific training on the use of the Internet after the examination. Six months later, at the midpoint of the second semester on another take-home examination, these students were asked to answer the same question about use of their resources. At that point, students had completed a total of twenty-four cases.

Analysis of written answers

The answers were coded for the types of resources the students used, how frequently they were used, and why they were used. A content analysis was per-

formed on the answers relating to the Internet in order to determine the categories of responses [14]. After reading the responses, the two authors developed categories for the search methods and for the critical evaluation criteria. These search method categories were consistent with the common Internet search methods currently available. The critical evaluation criteria developed were consistent with the literature on how to review information [15]. The critical evaluation criteria categories related to what the information source was, what methods were used to collect the data, how valid the data was, if references were cited, and if the information was peer-reviewed. Next, each paper was classified independently by the two authors according to the search strategies and evaluation criteria used. Whenever their independent records indicated a lack of agreement, the authors met to discuss the papers and to reach a consensus of how the answer would be classified. The number of search methods and evaluation strategies the students used were counted. Further, changes in their use patterns over time were analyzed.

RESULTS

All students stated that they used at least four different types of resources for both evaluations. These resource types included the Internet, books, textbooks, journal articles, reference materials, and human resources. Students uniformly recognized how essential a strong library collection was to their learning success. This recognition might be due in part to the self-selection that occurs with this kind of student-directed curriculum. These students have come into the curriculum with traditional library and print resource experiences. Individuals were consistent in the types of resources they cited both times. For example, some students preferred to use human resources whereas others did not use them either time. Two resources changed in their use patterns: textbooks and the Internet. Students indicated that they referred to a greater variety of textbooks in the first semester and they relied on one textbook more in the second semester. Student perception of the usefulness of resources, especially the Internet, and ability to evaluate these resources critically greatly changed during the six months between the two examinations. Overall, the students employed far more critical evaluation strategies as the year progressed.

Development of use patterns

Eight weeks into graduate school, twenty-four of twenty-five of the students (96%) stated that the Internet was their most helpful resource in gathering the information they needed to learn. All subsequent percentages were based upon those who used the Internet. For some, it was often their most consistently used resource. The perceived advantages of the Internet were that it was quick to use, was very accessible, contained a huge amount of information, and could support any point of view that the student was researching. For example, one student stated in retrospect, that at the beginning of the year he found 20,000 entries matching his query of interest. "In five seconds, I had more information at my fingertips than I could read in a year. I was so awestruck at the information available on the Internet that I often used it as my only resource. Not because I was too lazy to look elsewhere, but because I could not pull myself away from the little icons referring me to other information. I was finally surfing the 'net, and it seemed to have no limits."

Six months later, twenty-three of twenty-four students (96%) still used the Internet, however none of them still felt that it was their most useful source. At the later point, instead of it being a general source of information, students had very specific uses for the Internet, including:

- Nine of twenty-three (39%) wrote that it was an excellent starting point to get a general overview of the topic.
- Eight of twenty-three (35%) stated that it was very good for the following information:
  - accurate vital statistics (such as incidence and prevalence of specific diseases or the causes of morbidity and mortality in American subpopulations),
  - an understanding of the functions of organizations (such as the American Heart Association), or
  - the text or discussion of laws or regulations (such as what is covered under the Americans with Disabilities Act).
- Three of twenty-three (13%) stated that it was a good way to find out about patient information that is available to the lay public.
- Three of twenty-three (13%) felt that it was a good way to gain an understanding of the varied perspectives on any issue.

Search methods employed

While the students were not explicitly asked to describe their search methods, they illustrated some of their methods through their discussion of their critiques of the Internet. During the second semester, all of the students who used the Internet discussed at least one search method, such as going to specific URLs. Seventeen (74%) identified only this one search method. In addition, other students used search engines, meta-search engines, and hypertext linking methods. Three students (13%) identified three search methods, two (9%) identified two search methods, and one student (4%) discussed using four search methods. Six students (26%) wrote that they used search engines; one of these students also used a meta-search

Table 1
Evaluation of the Internet as a resource

Level of critical evaluation criteria	Midpoint 1st semester	Midpoint 2nd semester
Did not use Internet frequently	1/25	1/24
Merely listed resource: no explanation	5/24 (21%)	2/23 (10%)
Justified usefulness without critical evaluation	12/24 (50%)	2/23 (10%)
Evaluated strengths only	4/24 (17%)	1/23 (5%)
Evaluated strengths and weakness	3/24 (12%)	17/23 (75%)

engine. Five students (22%) discussed using hypertext links as a search method.

Use of specific sites

During the first semester, six of twenty-four students (25%) stated they relied on specific sites. In the second semester, 100% mentioned that they relied on specific government or professional organization sites such as the Centers for Disease Control or National Institutes of Health for most of their Internet information. One of the student's comments reflected the perspective of most of her peers: "The most obvious change from the first block to now is the manner in which I rely on information from the World Wide Web. Initially, this was probably the most frequent source of information for me: it was quick, accessible, and I could find a source supporting almost any point of view that I was researching. It was eventually this last aspect that made me realize the Web was not always the most reliable source of information, and I now consider the site quality when accessing Internet information. Government sites such as the Centers for Disease Control or sites sponsored by national organizations like the American Heart Association are Web sources that I would consider acceptable. The Web now serves as a source of basic, background information, rather than the answer to my learning objectives."

Evaluation of the Internet as a resource

Table 1 summarizes the students' levels of critical evaluation in their first and second semesters. Because most of the first semester students searched widely on the Internet without reading critically and evaluating the validity of the information gathered, only second semester evaluation criteria will be further discussed. A total of forty-two criteria were mentioned by the students. On the initial, independent classifications of the answers, the two authors agreed twenty-nine of forty-two times (69%). After discussing those answers where the authors did not classify the evaluation criteria entirely the same, the authors reached 100% agreement. Four students did not mention any evaluation criteria; five students mentioned only one evaluation criterion; seven discussed two; five students wrote about three; and two others described four evaluation criteria.

Critical evaluation criteria employed

The five evaluation criteria categories derived from the student answers were: (1) the validity of the information source; (2) the methods used to collect data; (3) the actual data; (4) the references, if any were cited; and (5) peer-review. The information source category was concerned with the reliability of the source. This category included considerations of bias, objectivity, and agenda of the person or organization responsible for the site. The methods criteria approximated the scientific method and included a systematic and objective procedure going from a question through data collection to analysis and conclusions based upon the data. For the data criteria, the students judged the facts presented on the basis of objectivity of collecting and reporting of data. Other factual considerations included verification, accuracy, currency, and validity of the facts or data presented. Students considered a site to be better if references were given. Students used these references to gather more information or to verify the data presented. The category of peer review related to quality control. Students recognized that much of the Web is not peer or professionally reviewed.

The most frequently used evaluation criterion category related to the source of the information with nineteen students (83%) discussing this category. One student commented, "When I use the Internet for research I mainly use sites that are produced by the government, well known journals or newspapers, reputable schools, and national organizations. Although I may read information that seems valid from a questionable site, I will either check their references or double check their facts with a textbook or journal article." Another student commented on the potential for bias on the Internet, "I read all of the Internet information extremely critically. Even several of the accurate sites have a clear bias. I always keep the agenda of the information providers in mind while reviewing the data." Another student wrote, "Whenever accessing information, a person must keep this in mind that the provider could have an agenda that misconstrues the data."

Thirteen students (56%) discussed criteria relating to the information presented. They discussed the importance of verification or accuracy of the facts or data and how up-to-date the information was. One student commented, "It is critical to evaluate the type of information with special care, comparing facts contained in anonymous articles with other resources to check for accuracy. Reading some of the recommended articles drawn from the Web helped prove the findings' accuracy."

Three students (13%) discussed employing criteria

that involved scientific methods. One student explained her evaluation criteria as a way of discrediting the information available on the Internet, "The information obtained also fails to show if it was gained from an independent, blind comparison, with a control group. Often you have no idea where the information came from so you cannot comment on or assess its validity. Having the actual data would help determine their applicability to other situations. Any recommendations that come from Web sites are often devoid of the study data on which they were based so one must consider recommendations made as needing corroboration from other sources. Overall, whereas I found the Web useful last block, my increasing critical analysis skills have led me away from this and toward the traditional medical literature to get satisfactory answers." Another commented, "You don't have the study in front of you to show you that it wasn't from a biased sample or that all of the subjects were accounted for at the end of the trial."

Four students (17%) mentioned references cited within the Web site as part of their evaluation scheme. Three students (13%) cited the importance of peer review as an evaluation strategy they employed.

DISCUSSION

The students changed their perceptions of the Internet as well as their uses of it. They started out as typical undergraduate students who surfed the Internet widely [16] and became quite selective and critical in their Web reading as the year progressed. The authors would like to attribute these changes to the educational demands placed upon them as graduate students in a problem-based learning curriculum. Students realized they needed to employ principles of evidence-based practice and be more rigorous about the information they gathered because of the program's expectations.

The depth of information wanted or perceived to be necessary varied from the beginning of the year to the end. During the first semester, many of the students probably only wanted an overview and, therefore, the Internet was sufficient. By the end of the first year, many of the students realized they needed more detailed information, more accurate and reliable data, or more analysis. Thus, the information available on the Internet found through common search engines might not have provided the best or most appropriate material available. The students' use of the Internet in the beginning of the year reflected what university professors have observed about undergraduate students. Undergraduate students have been reporting on many data, without checking on their reliability, not fully analyzing them, and not constructing a meaningful picture [17].

As the results of this study show, there was considerable variation among the students in the discussion of evaluation criteria throughout the year, but more so in the beginning of the year. Students applied their developing critical evaluation strategies to all resources they consulted, but most students explicitly discussed them in relation to the Internet. One explanation for these differences in the way the students answered the question related to their developing abilities to evaluate their resources. The students who wrote unsatisfactory answers in the first semester either did not realize the importance of evaluating and reflecting on their own resources or had not yet developed their critical evaluation skills. When one of the authors presented this study in a seminar to the students and faculty of the school, comments by students who had written the answers validated this interpretation. They said that they had no idea why the question was being asked in the beginning of the year or what they were supposed to write, and that they thought it was a stupid question. These same students were surprised that the whole class did not list strengths and weaknesses of the Internet by the end of the second semester. By the end of the year, they said they had a better understanding why this question was valid in a curriculum that emphasized the process of learning as well as the content to be learned.

The usefulness of the Internet is probably also dependent on the discipline being studied. The first semester emphasized epidemiology and the second semester emphasized the behavioral sciences. To have an understanding of the issues in the cases, students in the first semester were frequently required to obtain current statistics on the incidence and prevalence of diseases and the causes of morbidity and mortality. The Internet is indeed an excellent source of information for up-to-date statistical or epidemiological data information such as the number of white women between forty and fifty years old who died of breast cancer last year. It is not as good for finding an unbiased discussion of the application of a theoretical behavioral sciences model.

The change in number of textbooks over time is probably also explained by the subject matter. In focus groups at the end of the year, the students reported that they found biostatistics books hard to follow and therefore relied upon several to get a clearer picture. However, they stated that one textbook, recommended by the faculty, clearly explained the theoretical behavioral concepts thus eliminating the need to consult several resources.

Limitations of the study

How many students used the Internet before starting graduate school, or for what purposes is unknown. All data were self-reported with no other avenues for triangulation of data. It was impossible to determine the

association between amount of use and how critical the students were in their reading. However, the authors do know, both from self-report (described here) and observations of the faculty involved with these students, that most students used the Internet very frequently especially during the first six months of the program.

CONCLUSION

This study illustrates the development of critical evaluation skills in the use of the Internet with graduate students in a problem-based curriculum in public health. This program emphasizes the importance of critical thinking and evidence-based practice. By the end of the first year of study, the majority of the students demonstrated an understanding of these principles and applied them to their research and analysis of information resources.

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